

# Western Juniper and Cheatgrass

## Scientists Probe Invaders' Evolutionary Strategies

**A**fter you've spent a few grueling hours pulling weeds in your backyard, it may seem as if these unwelcome intruders have everything they need to get—and keep—the upper hand.

Agricultural Research Service ecologist Bill Longland and colleagues are discovering more about some of the special evolutionary advantages nature has bestowed on two particularly aggressive weeds of the American West—western juniper and cheatgrass.

Even its detractors may admit that western juniper, *Juniperus occidentalis*, can be an attractive tree. Though generally short statured, this evergreen can grow to a height of 80 feet or more. It crowds out tasty, nutritious understory plants that cattle and wildlife could otherwise graze or browse, such as bluebunch wheatgrass, squirreltail, and a mule deer favorite, bitterbrush.

Native plants can also be driven out by cheatgrass, *Bromus tectorum*, a fast-growing annual that looks something like a wild, scraggly version of wheat or oats. Depending on its environment, cheatgrass may only grow to be a few inches high or, in more favorable settings, perhaps 18-24 inches tall.

Both cheatgrass and western juniper cause fire-danger ratings to skyrocket. Cheatgrass burns hot, fast, and often. It's the culprit behind many of the headline-making wildfires that have ravaged the western United States of late.

After the fires, cheatgrass “can reinvade the burned landscape and get established well before native plants can take hold,” says Longland.

Cheatgrass has other drawbacks, as well. For example, its seeds have small, nasty spurs that can pierce the tender lips and gums of grazing animals, making them more vulnerable to infection.

This plant is native to Europe and Asia. Western juniper is a native of parts of California, Oregon, Nevada, Idaho, and Washington.

MICHAEL ASHLEY (D1458-1)



At a test site in Bedell Flat, north of Reno, Nevada, geneticist Michael Ashley (left) and ecologist William Longland count early emergence of cheatgrass seedlings to determine whether a high-density year is ahead for cheatgrass. High-density years pose the greatest danger of catastrophic range fires.

It's somewhat unusual for a native plant like western juniper to be regarded as an invasive weed, Longland points out. The trouble with western juniper is that, during the past 100 years or so, once-open woodlands of western juniper have become dense stands. Control of natural wildfires is thought to be one of the causes of this dramatic change in this ecosystem.

The thick woods rob understory plants of sunlight. They also block the movement of hefty cattle. That's a problem: If they're unable to find enough to eat from the shaded forest floor, cattle need to be able to move easily to greener pastures.

### Do Birds and Small Mammals Help Western Juniper?

Longland, who is with the ARS Exotic and Invasive Weeds Research Unit in Reno, Nevada, is beginning new studies to determine whether diplochory (pronounced DIP-low-core-ee), an evolutionary mechanism that helps plants disperse their seeds, has evolved in western juniper. Diplochory may be helping this tree trounce the competition.

“Diplochory involves the sequential services of two different agents of seed dispersal,” says Longland. In the case of western juniper, these agents might be birds and small mammals. “Their roles are to move seeds to protected locations where conditions for germination are favorable,” Longland says.

In the first phase of what seems to be diplochory in action, the trees' chunky berries, with seeds inside, are stolen by birds, mainly robins and Townsend's solitaires. The birds may carry the berries to a place where they can safely eat them.

Seeds swallowed by the birds may pass through their digestive systems and land on the ground, far from the parent trees. Says Longland, “A seed that would ordinarily grow near its parent, and compete with it for sunlight and nutrients, now has a chance to grow on its own, perhaps many miles away.”

In the second phase, small animals like deer mice, kangaroo rats, chipmunks, ground squirrels, and others, carry and cache the seeds excreted by the birds.

Just as the birds provide the air transport, the small mammals provide the ground service. “To germinate successfully, western juniper seeds have to be buried,” says Longland. Caching accomplishes that.

“Biologists have long recognized that fleshy fruits evolved in plants to attract animals that disperse seeds,” notes Longland. “What may surprise many people, though, is that seeds excreted by one type of animal may be an attractive food source for another type. And to produce the next generation of seedlings, plants may require both of those animals.”

In a preliminary study, Longland used a hidden network of motion- or heat-sensor-activated cameras to capture real-time snapshots of birds and furry animals holding juniper berries or seeds in their beaks or paws.

Though these caught-in-the-act candid strongly suggest diplochory at work, more evidence is needed, according to Longland. New studies, begun this year with co-investigators Steve Vander Wall of the University of Nevada-Reno and Diana Hiibel of the Reno-based Animal Ark Wildlife Sanctuary, will help fill in the knowledge gaps.

### Cheatgrass Myth Busted

The evolutionary advantage that cheatgrass may use pertains to how it fertilizes, or pollinates, its flowers, so that they will form viable seeds—and a new generation of plants.

Studies by Longland and ARS colleague Michael Ashley have shown, for the first time, that one cheatgrass plant can pollinate or fertilize another, also known as “cross-pollination” or “outcrossing.” Their finding is in contrast to the generally held opinion that cheatgrass plants are exclusively self-pollinating.

“Cross-pollination is an unarguable plus for this weed,” says Longland. “The exchange of pollen among individual cheatgrass plants can yield progeny with a genetic base that’s broader, or more diverse, than that of either parent. A broader

genetic base may give the new generations a greater ability to adapt to a wider range of environments and stresses.”

In contrast, plants that only self-pollinate may be less able to quickly adapt.

For their experiments, the scientists used what are known as “microsatellite markers” to determine whether the cheatgrass plants they sampled were self- or cross-pollinated. They published their findings in a 2007 issue of *Plant Species Biology*.

The cheatgrass research is part of ARS’s Areawide Pest Management Program for Annual Grasses in the Great Basin Ecosystem, a regional collaboration.

Right now, cheatgrass and western juniper run amok in much of the West. In time, studies of these errant species may lead to affordable, environmentally friendly ways to restore the natural balance of ecosystems today besieged by these powerful weeds.—By **Marcia Wood, ARS.**

*This research is part of Crop Protection and Quarantine, an ARS national program (#304) described on the World Wide Web at [www.nps.ars.usda.gov](http://www.nps.ars.usda.gov).*

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Cheatgrass.

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Students (fifth graders and up), teachers, environmentalists, scientists, policymakers, and others with a personal or professional interest in the alien species inhabiting the air, land, and water around us will want to check out this wide-ranging website. It offers the newest and best information about everything from Asian swamp eels to zebra mussels.

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Can’t find what you want? Give the center a call at (301) 504-6454 or send an e-mail to [invasive@ars.usda.gov](mailto:invasive@ars.usda.gov). Most inquiries are answered within a few business days.—By **Marcia Wood, ARS.**